

CLAIMS

1. An immersion probe comprising:

(a) a preassembled unit including a support tube defining the outer periphery of the unit, one end of said tube being an immersion end, at least one measuring element on a head, said head closing said tube adjacent said immersion end of said tube, a connector closing the other end of said tube, electrical conductors in said tube and extending from said connector to said measuring element;

(b) means on said tube for protecting the tube and for minimizing the ability of gasses to be trapped adjacent said element, said means including a heat insulating refractory sheath telescoped over a major portion of said tube beginning at said immersion end, said sheath being tapered toward said immersion end of said tube with the minimum wall thickness of the sheath being at said immersion end of the tube, said tube having an electrically conductive portion projecting beyond said sheath for contact with a bath of molten metal and being electrically coupled to said connector; and

(c) an elongated hollow support telescopically coupled to said other end of said tube for supporting the tube and sheath during immersion into a bath of molten metal.

2. An immersion probe in accordance with claim 1 wherein said sheath is resin coated molding sand.

3. An immersion probe in accordance with claim 2 including molding sand in said tube for protecting said conductors.

4. An immersion probe in accordance with claim 1 wherein the measuring element is a thermocouple characterized by the cold joints being closely adjacent and embedded in a gas tight body of electrically non-conductive material surrounded by the heat insulating material in said tube.

5. An immersion probe in accordance with claim 1 wherein the measuring element is a solid electrolyte electrochemical cell having an open end extending into said heat insulating material in said tube, said heat insulating material in said tube being gas permeable, and said electrically conductive portion of said tube completing the circuit to said cell.

6. An immersion probe in accordance with claim 1 wherein said sheath and support have concentric abutting ends surrounding said tube at a location closer to said other end of said tube than said immersion end, the outer diameter of said sheath and support being the same at the location where they abut one another.

7. An immersion probe in accordance with claim 4 wherein said thermocouple is disposed within a quartz tube coated on its outer surface with an aluminum oxide layer.

a 8. An immersion probe in accordance with claim 10 wherein the immersion end of said sheath has an external diameter of about 2.5 centimeters.

9. An immersion probe comprising:

(a) a preassembled unit including a support tube, one end of said tube being an immersion end, at least one measuring element supported by said tube adjacent said immersion end of said tube, a connector adjacent the other end of said tube, electrical conductors in said tube and extending from said connector to said measuring element, heat insulating material in said tube for protecting said conductors;

a (b) means on said tube for protecting the tube and for minimizing the ability of gasses to be trapped adjacent said element, said means including a heat insulating refractory sheath, *open at each end and* free of graphite and quartz, said sheath being telescoped over a portion of said tube beginning at said immersion end, said sheath being tapered toward said immersion end of said tube with the minimum wall thickness of the sheath being at said immersion end

of the tube, said sheath being non-transparent to thermal radiation, and

(c) an elongated hollow support telescopically coupled to one of said tube and sheath for supporting the tube and sheath during immersion into a bath of molten metal.

10. An immersion probe in accordance with claim 9 wherein the measuring element is a thermocouple having closely adjacent cold joints embedded in a gas tight body of electrically non-conductive material, said joints being positioned so as to be surrounded by said sheath.

11. An immersion probe in accordance with claim 9 wherein the measuring element is a solid electrolyte electrochemical cell having an open end extending into said heat insulating material in said tube, said heat insulating material in said tube being gas permeable, and at least a portion of said tube being electrically conductive for completing the circuit to said cell.

12. An immersion probe in accordance with claim 11 wherein said electrically conductive portion of said tube projects beyond said sheath for contact with a bath of molten metal.

13. An immersion probe in accordance with claim 9 wherein the immersion end of said sheath has an external diameter of about 2.5 centimeters.

14. An immersion probe in accordance with claim 9 wherein said sheath and support have concentric abutting ends surrounding said tube at a location remote from said immersion end, the outer diameter of said sheath and support being substantially the same at the location where they abut one another.

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